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Design and Manufacturing of Detection Device for Body Temperature and Blood Oxygen Level.

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Abstract:
During COVID pandemic, it's always risky to go out. But since unlock has begun and our life is coming back to normal, it is more important to be careful and health cautious. While working with different people, there are always chances to come in contact with COVID suspicious person.
To avoid this risk, we propose a health checking system for COVID suspect. In this, different sensors are used to measure critical parameters such as body temperature, pulse rate, SPO_2 (Saturated Oxygen level). This system will be useful for senior citizen or at offices and schools. With the help of this system, every visitor will be monitor. Here automatic sanitizer dispenser is added to clean hands after test. System will run on single phase AC supply.

Keywords: *COVID, SPO_2, Arduino, body temperature, pulse rate, Robot.*

1. INTRODUCTION

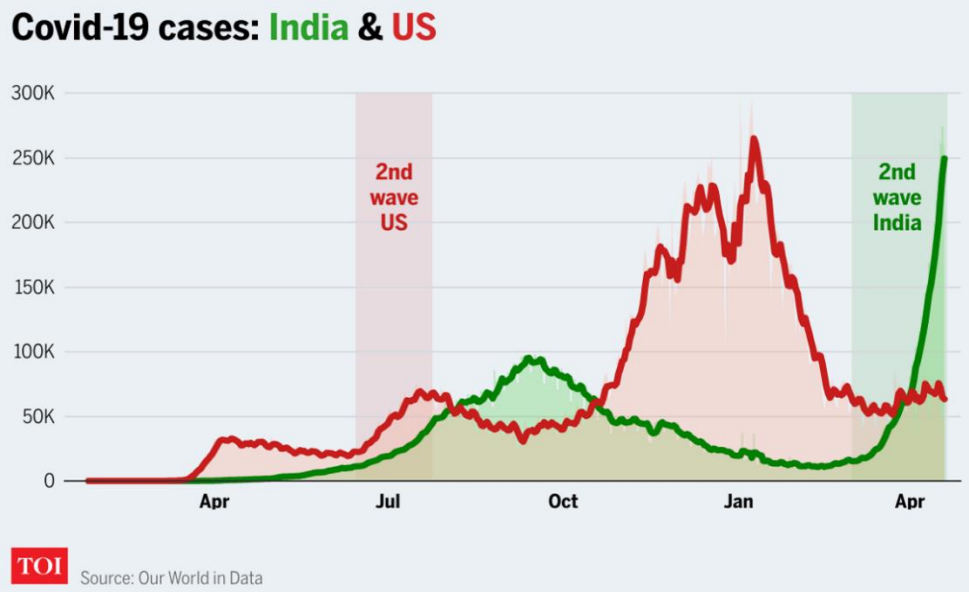

Fig. 1: India, US second Covid-19 wave compared by Times of India, Apr 20, 2021 [1]

Since December 2019 the world is under tremendous tension, the numbers are increasing day by day, and till date no vaccine has been full proved against the pandemic agent. Yes it is COVID-19, it was unknown to the race before it out broke in Wuhan, China. Being from a large family, a continuous mutation is occurring,

forbidding the researchers, microbiologist, and pharmaceuticals to draw the line of conclusion on the vaccine. Affecting the most prestigious countries in a chain; China, Italy, Spain, USA, India, Russia [1] the virus has proved its strength and subservient a technologically enhanced race. The policies taken worldwide have lessened its affect to some extent but could not eradicate it. Lockdown has economically weakened many nations, and testing of different medicines has also not proven to be satisfactory. The question now prevail is Life vs. Livelihood. The weaker section of the society is facing the hardship due to vigorous lockdown across the nations. Seeing the picture of India, one of the most promising countries in technology, the labourers are rushing for a little piece of grain. The starving faces reveal the pain. Industries are in losses, workers are losing jobs, economic growth of the nation has taken a back seat, but it should be realised that a regular monitoring of body temperature and periodical hand sanitization can prevent the spread of the pandemic to the masses.

Keeping in mind, the situation worldwide, sanitization commodities should be installed in each and every corner of the sphere, be it an industry, a corporate office, an educational institute or a shopping mall. During COVID pandemic, it's always risky to go out. But since unlock has begun and our life is coming back to normal, it is more important to be careful and health cautious. While working with different people, there are always chances to come in contact with COVID suspicious person.

To avoid this risk, we propose a health checking system for COVID suspect. In this, different sensors are used to measure critical parameters such as body temperature, pulse rate, SPO_2 (Saturated Oxygen level). This system will be useful for senior citizen or at offices and schools. With the help of this system, every visitor will be monitor. Here automatic sanitizer dispenser is added to clean hands after test. System will run on single phase AC supply.

2. LITERATURE SURVEY

2.1 Self-Activating Sanitizer with Battery Imposed System for Cleansing Hands:

Fig. 2: Self-Activating Sanitizer with Battery Imposed System for Cleansing Hands [1]

This paper [1] gives a brief idea about the automatic hand wash sanitizer. The motor pumps the sanitizer liquid or solution to the human while detecting the IR Sensor. The IR Sensor is the photodiode used for sensing the human hand detection and it is used to control the motor pump from the liquid. The motor is connected to an RC timer delay setup and the pipe connected to a reducer is used to control the flowing liquid of the sanitizer. It has three modes of Control LED's in the system, White LED is used for the user to understand that the setup is in working mode and battery is in use. Red LED is used for the user to understand

that Battery is in charging mode. Green LED is used for the user to understand that battery is in full charged mode. It has an On/ Off switch to control the whole setup from the battery supply. The consumer is convenient to use the setup and the user also saves costs and power.

2.2 Novel design of automatic sanitizer dispenser machine based on ultrasonic sensor:

Viruses such as COVID-19 are transferrable through touch and contact. There are WHO guidelines to clean or sanitize hands regularly to reduce the risk of infection. Dispensing of sanitizer from bottle and storage would require manual intervention. In this paper [2] author propose a novel design of touch-less sanitizer machine to reduce the risk due to contact. The system can sense the proximity with the help of ultrasonic sensor and sends signal to microcontroller. The controller processes the sensor data & actuates the pump and solenoid valve. The sanitizer liquid dispenses through mist nozzle.

In this paper, they designed a sanitizer dispensing machine in a plastic cabinet. The system consists of proximity sensor based on ultrasonic principle. The sensor used in the system is SR04 to sense the hands are under the machine or not. The cabinet design was originally fabricated for water RO system and has been modified for the purpose of sanitizer dispensing action. The sanitizer storage section is on the front side upper region. Filters have been removed and the water dispensing tap has also been removed. Mist nozzle has been added at the bottom side of the cabinet. The pump is used to suck the sanitizer and pump it with a pressure to the nozzle. The solenoid valve has also been used to control the opening of nozzle and to facilitate to control the dispensing of liquid sanitizer. Pipes and attachments helped to make it easy to fabricate.

2.3 Design and Implementation of a Smart Hand Sanitizer Dispenser with Door Controller using ATMEGA328P:

The main objective of this research paper is to design and implement a low cost touch free smart hand sanitizer dispenser with door controller that includes features such as ultrasonic sensor, LCD display and servo motor, based on Microcontroller.

In this paper [3], ultrasonic sensor (HC-SR04) to detect the presence of a hand. When it detects presence of hand below 10cm, it will trigger the first servo motor to move from 0 degrees to 180 degrees in order to pour the liquid on the hand. It will delay for two seconds before returning back to 0 degrees. After returning to 0 degrees, the electromagnetic lock will de-energize and a green LED will light up immediately, a word “The Entrance Door is Open” will appear on the LCD display then the second servo motor will open the entrance door. We added a delay of six (6) seconds to energize the electromagnetic lock and a delay of two seconds to reset the system. In this system, microcontroller is used to control all the attached devices across the external electronics equipment which are: ultrasonic sensor, servo motor, electromagnetic lock, LCD display and LEDs. The power supply provides the voltage and current required for effective performance of the system. The electromagnetic lock taps directly from the 12V DC power source and then Microcontroller and servo motor are fed with regulated DC power supply, which is 5V and 9V respectively.

2.4 A Human Support Robot for the Cleaning and Maintenance of Door Handles Using a Deep-Learning Framework:

The role of mobile robots for cleaning and sanitation purposes is increasing worldwide. Disinfection and hygiene are two integral parts of any safe indoor environment, and these factors become more critical in

COVID-19-like pandemic situations. Door handles are highly sensitive contact points that are prone to be contamination. Automation of the door-handle cleaning task is not only important for ensuring safety, but also to improve efficiency.

Fig. 3: HSR platform [4].

This work [4] proposes an AI-enabled framework for automating cleaning tasks through a Human Support Robot (HSR). The overall cleaning process involves mobile base motion, door-handle detection, and control of the HSR manipulator for the completion of the cleaning tasks. The detection part exploits a deep-learning technique to classify the image space, and provides a set of coordinates for the robot. The cooperative control between the spraying and wiping is developed in the Robotic Operating System. The control module uses the information obtained from the detection module to generate a task/operational space for the robot, along with evaluating the desired position to actuate the manipulators. The complete strategy is validated through numerical simulations, and experiments on a Toyota HSR platform.

2.5 Sanitization Robot:

The objective of this paper [1] was to minimizing human association as much as possible and thus automating the tasks such as sanitization with the help of robots. In this case, the use of robots can reduce human exposure to pathogens, which has become increasingly important as epidemics escalate. The paper uses Autodesk Fusion 360 software for its design and development of the sanitization robot. Arduino integrated development and HC-05 Bluetooth module used for control and programming. The design of the robot has a smile feature that helps in spreading positivity amidst these times.

This study presents a comprehensive overview of the robotics potential in medicine and allied areas with special relation to the control of the COVID-19 pandemic. Effective management of COVID-19 can significantly reduce the number of infected patients and casualties as witnessed in the case of the Chinese outbreak. Since, it has currently turned out to be a global challenge; technologically advanced countries can aid others by donating support equipment and robotic infrastructure to enable a good outcome in controlling

this disease. This review substantiates that the introduction of medical robotics has significantly augmented the safety and quality of health management systems compared to manual systems due to healthcare digitization. Classification of medical robots is only done using application-based categories to fit every aspect of hospital service ranging as well as fault tolerant control and dependable architectures for reliable and safe operation within the healthcare facilities.[1]

2.6 Novel design of automatic sanitizer dispenser machine based on ultrasonic sensor[2]

Hygiene is an important aspect to remain healthy. There are various aspects of hygiene. A clean hand is one of them. Hands generally are touched at various surfaces and can be exposed to direct contamination. Cleaning hands at regular interval is recommended by various health organizations including WHO. Hand hygiene is now regarded as one of the most important element of infection control activities. In the wake of the growing burden of health care associated infections (HCAIs), the increasing severity of illness and complexity of treatment, superimposed by multi-drug resistant (MDR) pathogen infections, health care practitioners (HCPs) are reversing back to the basics of infection preventions by simple measures like hand hygiene. This is because enough scientific evidence supports the observation that if properly implemented, hand hygiene alone can significantly reduce the risk of cross-transmission of infection in healthcare facilities (HCFs) [1–5].

They have designed a sanitizer dispensing machine in a plastic cabinet. The system consists of proximity sensor based on ultrasonic principle. The sensor used in the system is SR04 to sense the hands are under the machine or not. The cabinet design was originally fabricated for water RO system and has been modified for the purpose of sanitizer dispensing action. The sanitizer storage section is on the front side upper region. Filters have been removed and the water dispensing tap has also been removed. Mist nozzle has been added at the bottom side of the cabinet. The pump is used to suck the sanitizer and pump it with a pressure to the nozzle. The solenoid valve has also been used to control the opening of nozzle and to facilitate to control the dispensing of liquid sanitizer. Pipes and attachments helped to make it easy to fabricate.[2]

As the controller receive High signal from the sensor module it triggers the pump to pull water from storage area and send to the nozzle in mist form. The program runs the pump for 3 seconds. It has been seen during testing 3 seconds are sufficient to sanitize the hands with mist spray. Even we can change the time as per user need through program.

An automatic sanitizer dispensing machine designed and developed. The machine is wall mount at entrance gates of society, schools, colleges or any commercial building. It can spray 40 times with 100 ml liquid and is effective in optimize use of liquid sanitizer. The machine is tested for 24hour operation for more than a week and is working fine. It helped to reduce the contact for getting sanitizer and also reduce man power employed to spray sanitizer with a spray bottle. The power consumption is very low. For each spray the maximum current consumption is 2 Ampere at 24 V. It consumes 48W if run continuously for 1 hour. The control circuit is small in size and low cost as compared to available controllers. The power consumption is low and the system can help to achieve contactless sanitizer dispenser. It reduces the risk of community transmission of the virus.

2.7 Automatic Hand Sanitizer Container to Prevent the Spread of Corona Virus Disease

In early 2020, a virus emerged that was spreading rapidly to several countries. The first case related to the virus was reported in Wuhan, Hubei Province. [5]WHO named this disease the 2019 novel CORONA virus

(2019-nCoV), then changed its name to CORONA virus Disease (COVID-19) which was caused by the virus of Severe Acute Respiratory Syndrome CORONA virus-2 (SARS-Cov-2). This virus is zoonotic (a virus that is transmitted between animals and humans) and originates from bats. Besides, this virus can also be transmitted from humans to humans. CORONA virus can be transmitted either by air, direct contact, or indirectly. However, it is most commonly spread by droplets. Symptoms caused by this virus include the mild flu, namely a cold, sore throat, cough, fever, and difficulty breathing. In severe cases, Covid-19 can manifest as pneumonia. Patients can develop acute respiratory distress syndrome for a short time and die from multiple organ failure. The existence of this disease has a big impact on both socials and economics. WHO has declared this a pandemic disease and many cities around the world are in a lockdown situation. To prevent the cause of this virus, it can be done by keeping a distance at least 1 meter, avoid going to crowded places, avoid touching the eyes, mouth, and nose when outside and cleaning hands with soap or alcohol-based hand rub. Providing containers for cleaning fluids in public spaces is a form of Covid-19 prevention, but the provision of containers is currently ineffective because there are parts that are often touched. This could be a point of transmission for Covid-19. Many health actions are carried out using automatic systems including air quality monitoring, hand sanitizers, hand hygiene. Hand sanitizers are an alternative for washing hands during a pandemic. It can be used when and water are not available. Hand sanitizer is also available in several forms such as liquid (spray) or gel. Hand sanitizer is usually made from materials such as alcohol, polyacrylic acid, glycerin, propylene glycol, or plant extracts. The process of killing germs starts with removing the oil on the skin, then the bacteria in the body will come to the surface. Soap or alcohol will kill bacteria after rubbing to your hand. Hand sanitizer is effective against Covid-19.[5]

So far, most of the available hand sanitizers do not operate automatically. This aims to make an automatic hand sanitizer where soap and water can come out automatically. Besides that, automated hand sanitizer will make notification to the owner, if the liquid has run out to the smartphone. The infrared (IR) will sense the presence of heat and motion of the object and send data to the Arduino Uno so that it can activate the pump. If the water height is less than 10 cm, the ultrasonic sensor will send data to node ESC8266 as a Wifi microcontroller to the output devices such as smartphones or PC based on the Internet of Things (IoT). The results of the hand sanitizer testing that the system can run smoothly with a minimum detection error of transferring data.

The automatic hand sanitizer testing can run smoothly with a minimum detection error of transferring data. Infrared can detect the motion up to 50mm and ultrasonic sensor can detect the level of water with the distance to the sensor 35 cm. Ultrasonic sensor can send data to the MCU and Blink server and send notification to the user. So, it can be concluded that the system can work smoothly that can prevent the spread of Covid-19.

3. SCOPE OF PAPER

Keeping in mind, the situation worldwide, sanitization commodities should be installed in each and every corner of the sphere, be it an industry, a corporate office, an educational institute or a shopping mall. During COVID pandemic, it's always risky to go out. But since unlock has begun and our life is coming back to normal, it is more important to be careful and health cautious. While working with different people, there are always chances to come in contact with COVID suspicious person.

To avoid this risk, we propose a health checking system for COVID suspect. In this, different sensors are used to measure critical parameters such as body temperature, pulse rate, SPO_2 (Saturated Oxygen level). With the help of this system, every visitor will be monitor.

Table 1: Count of COVID cases in some of states in India by CSSEGIS and Data in May2021

States	Cases Detected (in Lacs)	Recovered (in Lacs)	Deaths
Maharashtra	56.9	53.1	93,198
Karnataka	25.5	21.5	27,806
Kerala	24.7	22.2	8,257
Tamil Nadu	20.1	16.7	22,775
Uttar Pradesh	16.9	16.1	20,053

3.2 Aim of the Paper

- To measure the heart rate
- To measure the amount SPO_2 level in blood
- To measure body temperature
- Display readings on LCD
- Provide buzzer alert when critical readings.
- Dispense sanitizer for cleaning hands.

4. METHODOLOGY:

Body parameters will be measure using different sensors like blood oxygen, heart rate, body temperature are considerable for COVID infection. To avoid this risk, we propose a health checking system for COVID suspect. In this, different sensors are used to measure critical parameters such as body temperature, pulse rate, SPO_2 (Saturated Oxygen level). With the help of this system, every visitor will be monitor. Here automatic sanitizer dispenser is added to clean hands after test. System will run on single phase AC supply.

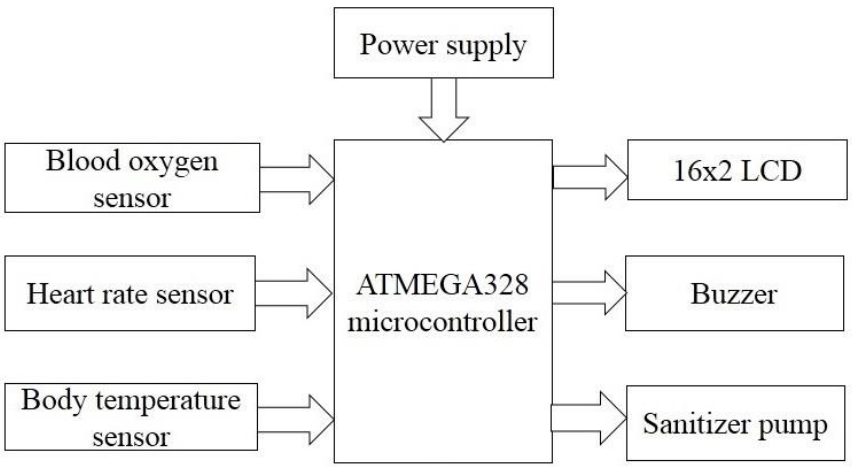

Fig.4: Block Diagram

Output of different sensors given to microcontroller. Microcontroller ATmega328 measures this parameters and displays on 16x2 LCD. Body temperature will be measured by LM35 sensor. This sensor provides analog

output voltage.[4] This will be measured by inbuilt ADC of microcontroller. Whereas, heart rate and blood oxygen is measured using MAX30100 SpO_2 sensor. This sensor communicate microcontroller using i2c communication protocol. If person has suspicious reading for COVID, system will turn on buzzer. User can sanitize hands using hand sanitizer dispenser after testing.

5. DETAILS OF DESIGN:

5.1 Components Required:

5.1.1 ATmega328: ATmega328P is a high performance yet low power consumption 8-bit AVR microcontroller that's able to achieve the most single clock cycle execution of 131 powerful instructions thanks to its advanced RISC architecture. It can commonly be found as a processor in Arduino boards such as Arduino Fio and Arduino Uno. ATmega328P is one of the high performances AVR technology microcontroller with a large number of pins and features. It is designed by 8-bit CMOS technology and RSIC CPU which enhance its performance and its power efficiency get improved by auto sleeps and internal temperature sensor. This ATmega328P IC comes with internal protections and multiple programming methods which helps the engineers to priorities this controller for different situations. The IC allows multiple modern era communications methods for other modules and microcontrollers itself, which is why the microcontroller ATmega328P usage has been increasing every day.[4]

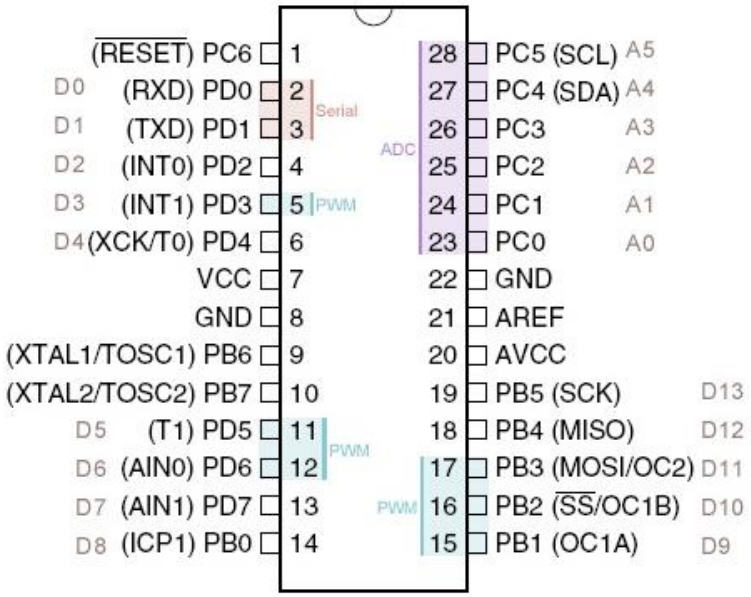

Fig. 5: Pin diagram of Atmega328 microcontroller

Features:

- 28 pin IC with 20 GPIO pins
- Inbuilt 6 channel ADC
- 2kb SRAM, 1kb EEPROM
- 32 General purpose registers
- Works on 5V
- Low power Sleep mode
- Multiple software tool support

5.1.2 Submersible Motor Pump: A submersible pump is an air-tight sealed motor close coupled to the pump body. Submersible pumps are very efficient because they spend less energy moving water into the pump, the water pressure pushes the water into a submersible pump, thus "saving" a lot of the pump's energy.
Features:

- Type: submersible mini water pump
- Voltage supply: 2.5 – 6 v
- Current supply: 130 – 220 mA
- Water lift: 40 to 110 mm
- Flow rate: 80 to 120 l/h

Fig. 6: Submersible Motor Pump

5.1.3 Blood oxygen and heart rate sensor: Maxim's MAX30100 is integrated pulse oximetry and a heart-rate sensor. It's an optical sensor that derives its readings from emitting two wavelengths of light from two LEDs – a red and an infrared one – then measuring the absorbance of pulsing blood through a photo detector. This particular LED colour combination is optimized for reading the data through the tip of one's finger.
The signal is processed by a low-noise analog signal processing unit and communicated to the target MCU through the micro BUS I2C interface. Developers of end-user applications should note that the readings can be negatively impacted by excess motion and changes in temperature. Also, too much pressure can constrict capillary blood flow and therefore diminish the reliability of the data. A programmable INT pin is also available. It operates at the 3.3V power supply.
Features:

- It is an integrated pulse oximetry and heart rate monitor sensor solution.
- Simple Voltage input range : DC 0-25 V;
- Optical sensor: IR and red LED combined with a photodetector
- Measures absorbance of pulsing blood
- I2C interface plus INT pin
- Ultra low power operation increases battery life for wearable devices
- Advanced functionality improves measurement performance,
- High SNR provides
  Ambient, light cancellation

Fig. 7: Max30100 Module

5.1.4 Body temperature sensor: LM35 is temperature sensor IC which provides analog output voltage proportional to surrounding temperature. The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration.

Specifications:

- Calibrated Directly in Celsius (Centigrade)
- Linear + 10-mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at 25°C)
- Rated for Full −55°C to 150°C Range
- Operates from 4 V to 30 V
- Less than 60-µA Current Drain

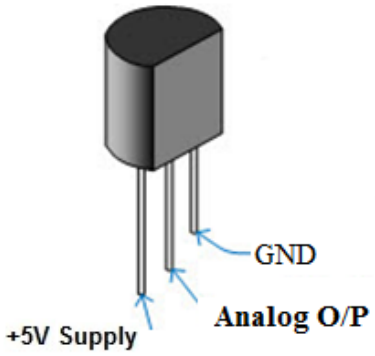

Fig. 8: LM35 sensor

5.1.5 Diode: Diode is a electronic device that allows the passage of current in only one direction. The first such devices were vacuum-tube diodes, consisting of an evacuated glass or steel envelope containing two electrodes – a cathode and an anode. The diodes commonly used in electronic circuits are semiconductor diodes. There are different diodes used in electronic circuits such as Junction diode, zener diode, Photo diodes, and tunnel diode.

Fig. 9: Diode

5.1.6 16x2 LCD: LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. But the most used one is the 16*2 LCD, hence we are using it here. All the above mentioned LCD display will have 16 Pins and the programming approach is also the same and hence the choice is left to you. Below is the Pin-out and Pin Description of 16x2 LCD Module:

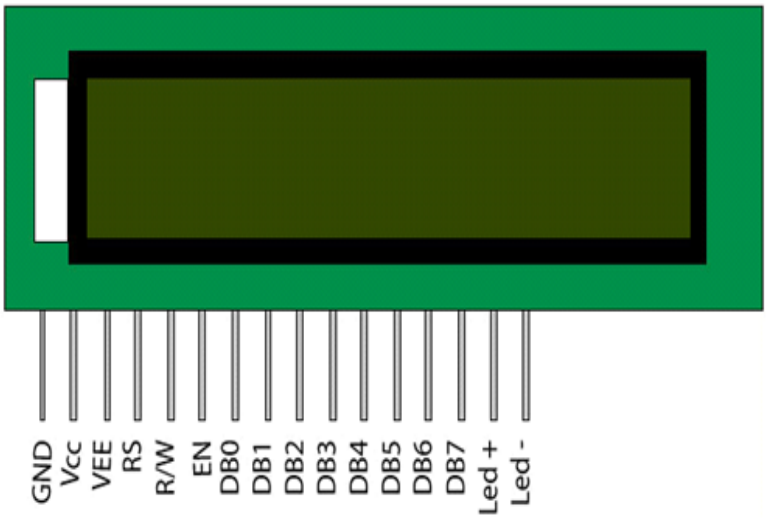

Fig. 10: 16x2 LCD

4-bit and 8-bit Mode of LCD: The LCD can work in two different modes, namely the 4-bit mode and the 8-bit mode. In 4 bit mode we send the data nibble by nibble, first upper nibble and then lower nibble. For those of you who don't know what a nibble is: a nibble is a group of four bits, so the lower four bits (D0-D3) of a byte form the lower nibble while the upper four bits (D4-D7) of a byte form the higher nibble. This enables us to send 8 bit data. Whereas in 8 bit mode we can send the 8-bit data directly in one stroke since we use all the 8 data lines. But 8-bit mode is faster and flawless than 4-bit mode. But the major drawback is that it needs 8 data lines connected to the microcontroller. This will make us run out of I/O pins on our MCU, so 4-bit mode is widely used. No control pins are used to set these modes. It's just the way of programming that change.

Read and Write Mode of LCD: As said, the LCD itself consists of an Interface IC. The MCU can either read or write to this interface IC. Most of the times we will be just writing to the IC, since reading will make it

more complex and such scenarios are very rare. Information like position of cursor, status completion interrupts etc. can be read if required, but it is out of the scope of this tutorial. The Interface IC present in most of the LCD is HD44780U, in order to program our LCD we should learn the complete datasheet of the IC.

Table 2: Pin description of 16x2 LCD

Pin No.	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; the best way is to use a variable resistor such as a potentiometer. The output of the potentiometer is connected to this pin. Rotate the potentiometer knob forward and backwards to adjust the LCD contrast.	Vo / VEE
4	Selects command register when low, and data register when high	RS (Register Select)
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given; Extra voltage push is required to execute the instruction and EN(enable) signal is used for this purpose. Usually, we set en=0, when we want to execute the instruction we make it high en=1 for some milliseconds. After this we again make it ground that is, en=0.	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

LCD Commands: There are some preset commands instructions in LCD, which we need to send to LCD through some microcontroller. The purpose of using 16x2 LCD in our paper is to display all the parameters of solar panel and is connected to pin no 37 and 38 of microcontroller.

Interface Pin Description:

Features:

- 16x2 matrix
- Low power operation support: 2.7 to 5.5V.
- Duty cycle: 1/16.
- Connector for standard 0.1-pitch pin headers.

5.1.7 Buzzer: A buzzer or beeper is an audio signal device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. If embedded system is misplaced from dashboard, the IR sensor becomes active. The signal is sent to microcontroller to ring the buzzer. It is connected to the pin no.28 of microcontroller.

Fig. 11: Buzzer

5.1.8 Capacitor: Capacitor is a passive 2 terminal electrical component that stores electrical energy when they are connected to battery or some other charging circuit. The effect of capacitor is known as capacitance. The capacitor contains 2 metallic plates that are separated by some form of insulation. Capacitance is usually measured in the farad unit. They are commonly placed in electronic components and are used to maintain a power supply while the device is unplugged and without a battery for a short time. Here, in our paper we are using 0.1uf, 100uf, 450uf, 470uf.

Fig. 12: Capacitors

5.1.9 Resistor: A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law: V = IR

Resistors are used as part of electrical networks and electronic circuits. They are extremely commonplace in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).

The primary characteristics of resistors are their resistance and the power they can dissipate. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage. Critical resistance depends upon the materials constituting the resistor as well as its physical dimensions; it's determined by design.

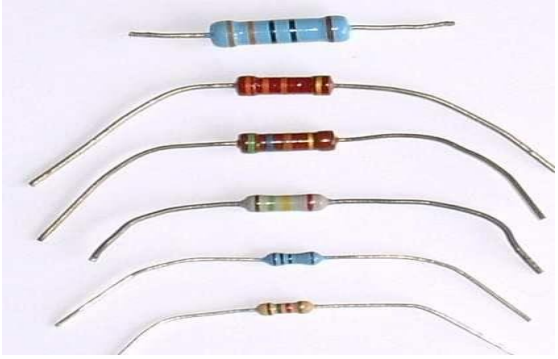

Fig. 13: Resistor

Resistors can be integrated into hybrid and printed circuits, as well as integrated circuits. Size, and position of leads (or terminals) are relevant to equipment designers; resistors must be physically large enough not to overheat when dissipating their power.

5.1.10 Voltage Regulator: Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 Voltage Regulator, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

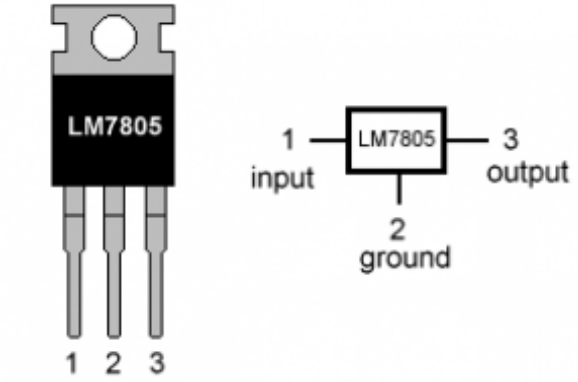

Fig. 14: Pin-out of 7805

There is a significant difference between the input voltage & the output voltage of the voltage regulator. This difference between the input and output voltage is released as heat. The greater the difference between the input and output voltage, more the heat generated. If the regulator does not have a heat sink to dissipate this heat, it can get destroyed and malfunction. Hence, it is advisable to limit the voltage to a maximum of 2-3 volts above the output voltage. So, we now have 2 options. Either design your circuit so that the input voltage going into the regulator is limited to 2-3 volts above the output regulated voltage or place an appropriate heat sink that can efficiently dissipate heat.

Table 3: Pins of 7805

Pin No.	Pin	Function	Description
1	INPUT	Input voltage (7V-35V)	In this pin of the IC positive unregulated voltage is given in regulation.
2	GROUND	Ground (0V)	In this pin where the ground is given. This pin is neutral for equally the input and output.
3	OUTPUT	Regulated output; 5V (4.8V-5.2V)	The output of the regulated 5V volt is taken out at this pin of the IC regulator.

7805 voltage regulator is not very efficient and has drop-out voltage problems. A lot of energy is wasted in the form of heat. If you are going to be using a heat sink, better calculate the heat sink size properly. The below formula should help in determining appropriate heat sink size for such applications.

Heat generated = (input voltage – 5) x output current

If we have a system with input 15 volts and output current required is .5 amperes, we have:

(15 – 5) x 0.5 = 10×0.5 =5W;

5W energy is being wasted as heat, hence an appropriate heatsink is required to disperse this heat. On the other hand, energy actually being used is: (5 x 0.5Amp) = 2.5W. So twice the energy, that is actually utilized is wasted. On the other hand, if 9V is given as input at the same amount of load: (9-5) x 0.5 = 2W. So here 2W energy will be wasted as heat.

5.2 Design of Regulated Power Supply:

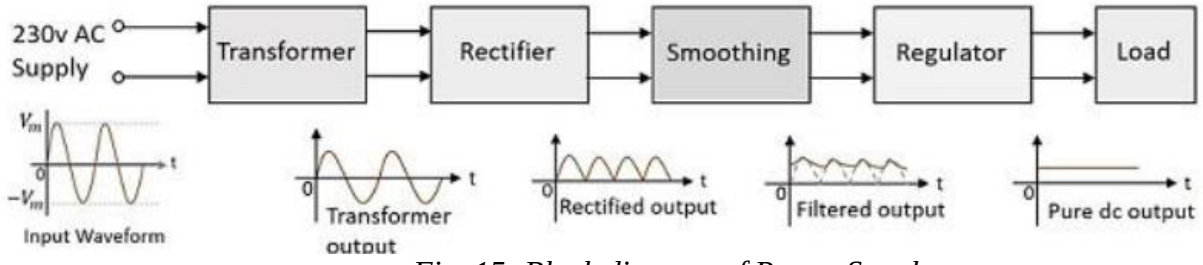

Fig. 15: Block diagram of Power Supply

When working with electronics, we always need one basic thing: Power. In every electronic circuit power supply is required. The proper working of each and every component, the exact amount of voltage and current is to be supplied to it. If the power exceeds its limit, it can be fatal.

5.2.1 Design of Step Down Transformer: The following information must be available to the designer of the transformer.

1) Power output.
2) Operating voltage.
3) Frequency range.
4) Efficiency and regulation.

Size of core is one of the first consideration in regard of weight and volume of a transformer. This depends on type of core and winding configuration used. Generally following formula is used to find Area or Size of the Core.

$$Ai = \sqrt{Wp} / 0.87$$

Where, Ai = Area of cross section in square cm.

Wp = Primary Wattage.

For our paper we require +5V output, so transformer secondary winding rating is 9V, 500mA. So secondary power wattage is,

$$P2 = 9 * 500 \text{ mA}$$
$$= 4.5\text{Watt}$$

So,
$$Ai = \sqrt{4.5} / 0.87$$
$$= 2.4$$

Generally 10% of area should be added to the core. So, Ai = 2.8

Now turns per volt: - Turns per volt of transformer are given by relation.

$$\text{Turns per volt} = 100000 / 4.44\, f * Bm * Ai$$

Where, F= Frequency in Hz.

Bm = Density in Wb / Square meter.

Ai = Net area of the cross section.

Following table gives the value of turns per volt for 50 Hz frequency. Generally lower the flux density better the quality of transformer. For our paper we have taken the turns per volt is 0.91 Wb / sq.m from above table.

$$\text{Turns per volt} = 50 / Ai$$
$$= 50 / 2.8$$
$$= 17.85$$

Thus the turns for the primary winding are,

$$220 * 17.85 = 3927$$

And for secondary winding, $9 * 17.85 = 160$

Table 5: Specifications for Flux Density

Flux density 0.76 Wb /sq m	1.14	1.01	0.91	0.8
Turns per Volt 45 / Ai	40 / Ai	45 / Ai	50 / Ai	55 / Ai

Wire Size:- As stated above the size is depends upon the current to be carried out by winding which depends upon current density. For our transformer one tie can safely use current density of 3.1 Amp / sq.mm. For less

copper loss 1.6Amp/sq.mm or 2.4sq.mm may be used generally even size gauge of wire are used. R.M.S secondary voltage at secondary to transformer is 9V.

So maximum voltage across secondary = Vm = 9 * 1.141
= 12.727v

D.C output voltage Vm across secondary is Vdc = 2 * Vm/pi
= 2 * 12.727/3.14
= 8.08 V

5.2.2 Selection of Diode for Rectifier:-

P.I.V rating of each diode is 2Vm

PIV = 2 * 8.08= 16.16 V

Maximum forward current, which flow from each diode is 500 mA. So from above parameter, we select diode IN4007 from the diode selection manual.

5.2.3 Selecting Filter Capacitor:-

Formula for calculating filter capacitor is

$$C = \frac{1}{4} \sqrt{3}\ r * F * R1$$

Where,

r = ripple present at output of rectifier, which is maximum 0.1 for full wave rectifier.

F = frequency of AC main.

R1 = input impedance of voltage regulator IC

$$C = \frac{1}{4} \sqrt{3} * 0.1 * 50 * 28 = 1030\ \mu f = 1000\ \mu f$$

Voltage rating of filter capacitor should be greater than the i/p Vdc i.e. rectifier output which is 8.08 V so we choose 1000µf / 25V filter capacitor.

5.2.4 Selecting Voltage Regulator IC:-

Table 6: Specification of Regulator IC

Parameter	Rating
Available output DC voltage.	+5V
Line regulation.	0.03
Load regulation.	0.5
Vin maximum.	16.16 V
Ripple rejection.	60-80db

5.3 Selection of Microcontroller Programming Tool:

Once microcontroller is selected, selecting a perfect development tools is most important. For develop every microcontroller based system, a set of software and hardware tools are required. Software tools for editing, debugging and troubleshooting the microcontroller program. While hardware tools, for burning computer code into microcontroller and testing microcontroller hardware. A good development tools must have following properties:

- Simple to use
- Not many steps execution
- Inexpensive

- Must include basic functions like editor, debugger, compiler
- Must include power supply and basic hardware required and I/O pins connector facility
- Cross-platform development
- Must support different programming language and computer operating system

5.3.1 Arduino IDE Software:

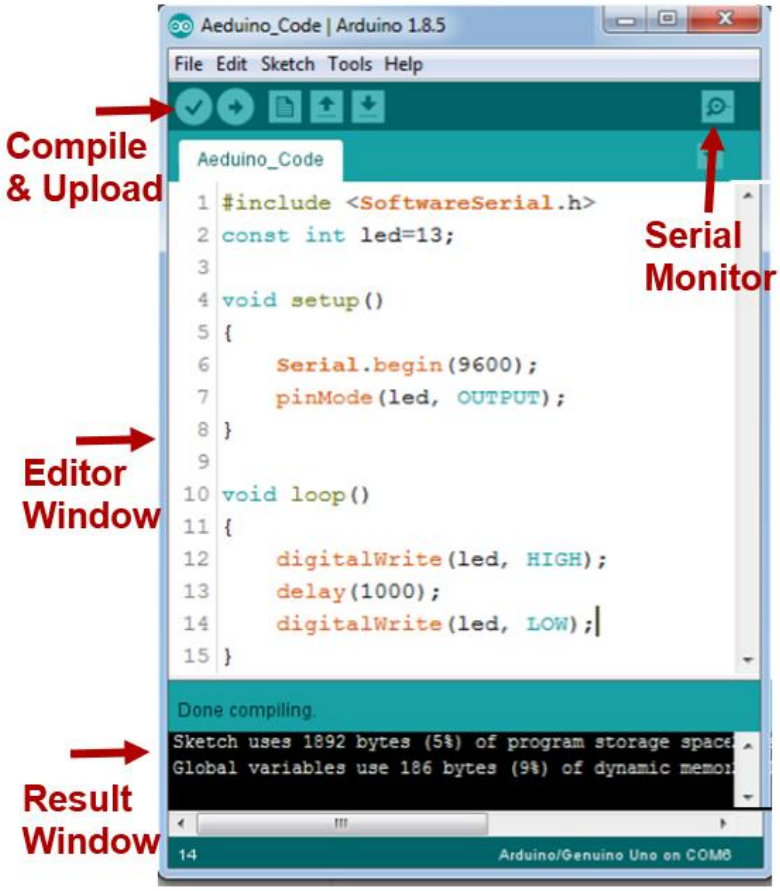

Fig. 16: Arduino IDE Software Window

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio. The Arduino project provides the "Arduino Integrated Development Environment" (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and

output procedures. A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub *main()* into an executable cyclic executive program:

setup(): a function that runs once at the start of a program and that can initialize settings.

loop(): a function called repeatedly until the board powers off.

After compiling and linking with the GNU tool chain, also included with the IDE distribution, the Arduino IDE employs the program *avr dude* to convert the executable code in to a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

Features of Arduino IDE:

- Simple and easy program format.
- Writing and editing of Sketches.
- Already written sample programs which are generally use.
- Easy to compile the program, with single click.
- Easy Uploading, with single click.
- Pre-defined Libraries in wide variety of application.
- Can be used with third party hardware.
- Contents of serial communication can be seen on 'Serial Monitor'.
- Supports multiple languages.

5.3.2 Arduino Uno Board

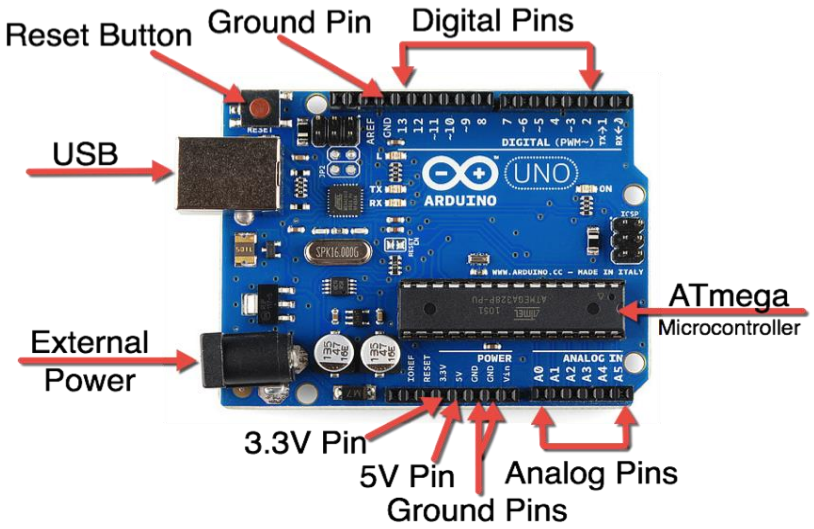

Fig.17: Arduino Uno Development Board

Arduino Uno is ATMEGA328P microcontroller board based. It has 14 digital input/output pins of which 6 can be used as PWM outputs and 6 analog inputs/outputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started.

Features of Arduino Uno Development Board:

- Easy to program or reprogram: The Uno can be program or reprogram with the ARDUINO SOFTWARE (IDE). The ATmega328 on the Uno comes pre-programmed with a boot loader that

allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol.

- Warnings: The Uno has a resettable polyfuse that protects your computer's USB ports from shorts and over current. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.
- Power: The Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter or battery.
- Memory: The ATmega328 has 32 KB including 0.5 KB occupied by the boot loader. It also has 2 KB of SRAM and 1 KB of EEPROM, which can be read and written with the EEPROM library.

Other Advantages of Arduino Board:

- Inexpensive: Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than 500 rupees.
- Cross-platform: The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- Simple programming environment: The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.
- Open source and extensible software: The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- Open source and extensible hardware: The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of module in order to understand how it works and save money.

5.3.3 Proteus-8.0: PCB Layout Design Software

Proteus professional is a software combination of ISIS schematic capture program and ARES PCB layout program. This is a powerful and integrated development environment. Tools in this suit are very easy to use and these tools are very useful in education and professional PCB designing. Professional PCB designing software with integrated space based auto router.

Step 1: Run the ISIS professional program by clicking the icon on the desktop. Work space with interface buttons for designing circuit will appear. Note that there is a blue rectangular line in the workspace; make sure that whole circuit is designed inside the rectangular space.

Step 2: Select the components from library and connect according to circuit.

Step 3: After completion of designing, save with some name and debug it.

Step 4: Proteus has the integrated ARES PCB designing suit. By using this we can easily develop the PCB layout. After simulation save the circuit designing and click on tools then select net list to ARES. Then a window will open with list of component packages.
Step 5: Create a board edge by selecting 2D graphics box mode. Next click on the select layer at bottom left corner and select the board edge option.
Step 6: Click on the component name and change the angle of the component by using rotation arrow options if required. Then place the component on the work space.
Step 7: After placing the all components in correct position, next thing is tracking. Select the track mode by clicking the track mode button, and change the track width by clicking “C” create or “E” edit buttons
Step 8: Select the width of the track from given list. It is better to select between 25, 40 as needed.
Step 9: Next thing is create tracks between components. Connection representation in green line and yellow line shows the direction. After setting the track width click at the component one end with pen and follow the green line. When two components are successfully connected then green line will removed automatically.
Step 10: In single layer PCB components are placed at one side and connections (tracking) done in another side. Coming to duel layer PCB, tracking is done in two sides and components are placed in two sides also. In this type mostly SMD components are used. Next finally multi layered PCB‟s, in these many layers are used. In this two are top and bottom layers and remaining all are inner layers. In Proteus we can design up to 16 layers PCB. One is top layer, another one is bottom layer and remaining all are inner layers. The layer selection in Proteus is at left down corner.
Step 11: The next step is auto-router. This is special tool to arrange tracks automatically without errors. When we select this tool, automatically shape based auto router window will open. This window having the execution mode, design rules and grid width changing options. By changing all options according to our requirement and click the button begin routing automatically routing will start.
Step 12: After completion of tracking save the project in same folder where the above Proteus project saved. In Proteus we have one other tool that how the circuit is been looking like after completion.
Step 13: To see the final circuit, click on output in menu bar and then select 3D visualization. Then the circuit visualization will open in other window. It is having the features of all angles visualization, components less board view and back layer view.
Step 14: The final step of PCB layer designing is layout printing. Taking prints of board layer is the final step. So to take print of the circuit layout, click on output in menu bar and click on print. Then print layout setup window will open. While printing the bottom copper layer one important thing is reflection selection. That should be selected in mirror mode.

5.5 PCB Layout:

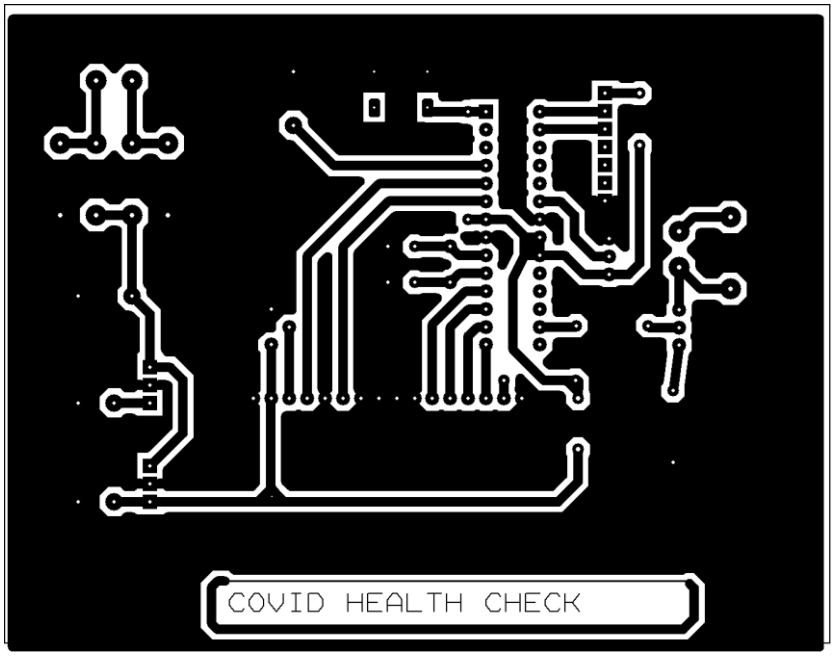

Fig.18: PCB Layout of System

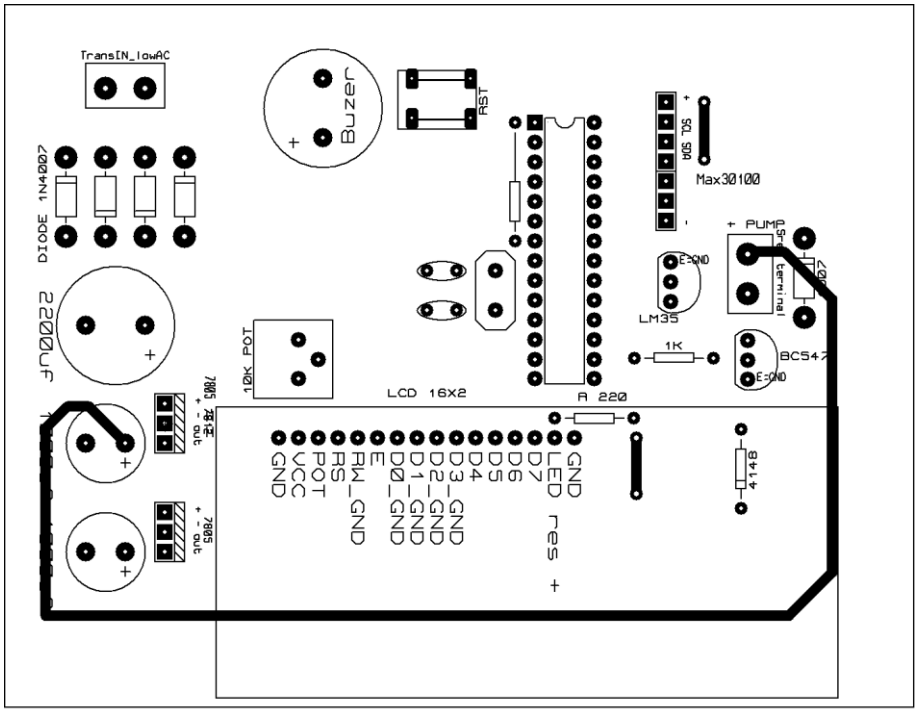

Fig.19: Component Side of PCB

5.4 Circuit Diagram:

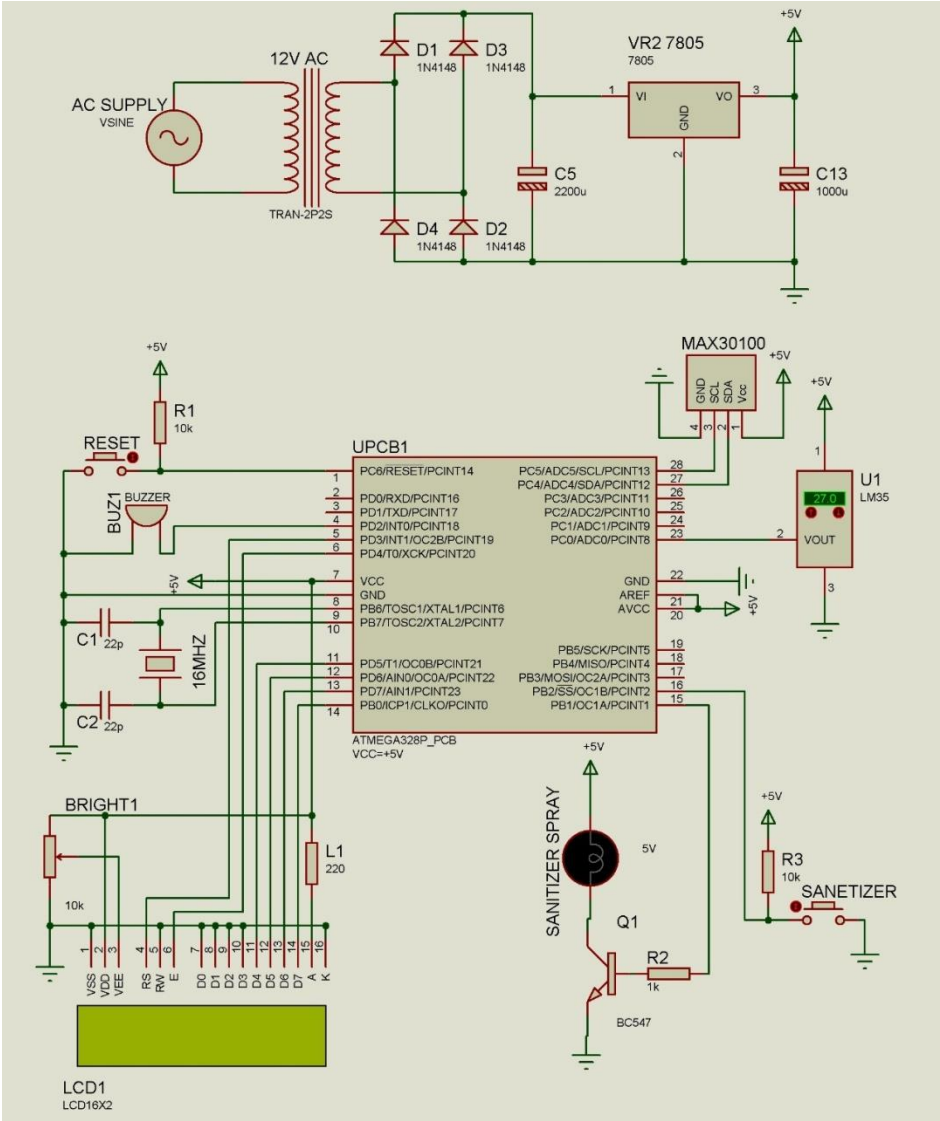

Fig.18: Circuit Diagram of System

6. ADVANTAGES, DISADVANTAGES AND APPLICATIONS:

6.1 Advantages:

- It will help to detect the COVID suspect
- 24x7 operation
- Low cost solution to make the surrounding safe

6.2 Limitation:

- Due to the use of AC supply as power source, we cant move it with us easily.

6.3 Applications:

- In Hospitals
- Offices
- Public Places like schools, cinema theaters, Shopping Malls, Bus stop

7. CONCLUSION:

In this paper by considering all the situations and possibility, we decided the specification. By chosen components and sensors which are helping to achieve the desire target. Though, design of circuit is critical due to non-availability of some of module in Protius software. Whereas due to the use of Arduino development tools, reduce difficulties during programming & troubleshooting was reduced.

We believe that after installation of this project, it will help to reduce the spreading of COVID by detecting suspects on the basis of body temperature and blood oxygen level of every person.

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